

REMARKS

In the Office Action of November 19, 2002, Claims 15 - 22 were rejected and Claims 23 - 27 were allowed. In response, Claims 15 and 18 are amended and new Claims 28 - 36 are added to the application. Reexamination and reconsideration are respectfully requested in view of the foregoing amendments and the following remarks.

Indicated Allowable Subject Matter

Paragraph 2 of the Office Action stated that the indicated allowability of Claims 23 - 27 was withdrawn in view of Kunikiyo, U.S. Patent No. 5,668,403. However, the Office Action did not contain any specific rejection of Claims 23 - 27 over Kunikiyo. Further, paragraphs 5 and 6 of the Office action stated that Claims 23 - 27 were allowed and provided a statement of reasons for allowance. By a telephone discussion on December 8, 2003, the Examiner confirmed that Claims 23 - 27 are allowed and that the statement that the allowability of Claims 23 - 27 was withdrawn was in error.

Amendments and New Claims

Claims 15 and 18 are amended to clarify that the heat treatment is conducted where the oxide film is formed on the surface of an element-forming area, that is, the area on which a gate oxide film and a gate electrode are to be formed.

Claim 28 is a variation of the subject matter of Claims 15 and 18.

Claims 29 and 30 are supported by Example 2, wherein Example 1 is referred to as a preferred embodiment.

Claim 31 is supported by Example 3, wherein Example 1 is referred to as a preferred embodiment.

Claim 32 is supported by the description on page 12, lines 8 - 9.

Claim 33 is supported by the description on page 12, line 8.

Claim 34 is a product-by-process claim depending from Claim 28.

Claim 35 is supported by Example 3, wherein Example 1 is referred to as a preferred embodiment.

Claim 36 is supported by Example 3, wherein Example 1 is referred to as a preferred embodiment.

Rejection of Claim 18 - 20 under 35 U.S.C. §102(e) over Kunikiyo

Claims 18 - 20 were rejected under 35 U.S.C. §102(e) as anticipated by Kunikiyo (U.S. Patent No. 5,668,403). Regarding Claim 18, the Office Action alleged that Kuniyiko teaches oxidizing a main surface of a silicon substrate, forming an oxidation-preventing film on portions of the oxidized silicon substrate, removing a part of the oxidation-preventing film that is located in an element-separating area, forming an element-separating oxide film on the silicon substrate in the element-separating area after removing the part of the oxidation-preventing film, then, carrying out a heat-treatment at a temperature of 800°C or higher in an inert atmosphere; and that the reference further teaches forming a gate oxide film over the heat-treated silicon substrate. The Examiner acknowledges that Kunikiyo fails to expressly teach forming a thermal oxide on the silicon substrate by oxidizing the silicon substrate; and after forming the thermal oxide, carrying out the heat treatment. However, Examiner takes the position that the thermal oxidation step is

not distinguishable from the element separating oxide and that they could reasonably be one and the same step. Regarding Claim 19, the Examiner alleges that Kunikiyo teaches that the heat treatment is carried out in an atmosphere of an inert gas selected from nitrogen, said gas mixture being able to contain 5% or less of oxygen. Regarding Claim 20, the Examiner alleges that Kunikiyo teaches that the oxide film is kept in a bare state during the heat-treatment for stress relaxation.

This rejection is respectfully traversed as it may be applied to Claims 18 - 20 as amended herein and to new Claims 28 - 36. As discussed in Applicant's previous response, the process of the present invention comprises depositing a silicon nitride film on a substrate, forming a LOCOS (element separating oxide film), removing the deposited silicon nitride film, and conducting thermal treatment on the region of the substrate from which the silicon nitride is removed, said region of substrate having a silicon oxide film thereon. The process includes an embodiment of a part of Example 1 wherein the pad oxide film is retained at the time of forming the pad oxide film on the substrate by thermal oxidation of the substrate before forming the silicon nitride film, and Example 2 wherein a thermal oxide film is formed on the substrate after formation of LOCOS.

In Kunikiyo, on the other hand, it is only disclosed that after forming a LOCOS oxide film, the nitride film 3 and the underlying oxide film 2 around the LOCOS are removed to expose the substrate 1, followed by heat treatment in a nitrogen atmosphere. Kunikiyo does not disclose that a high temperature heat treatment is conducted while the substrate around the element isolation region is covered with an oxide film as in the present invention.

When the heat treatment is conducted in a nitrogen atmosphere after forming the element isolation region, and exposing the substrate after removing the surface oxide film therearound as taught by Kunikiyo, the exposed substrate surface is subjected to formation of thin nitride film, which would have to be removed before subsequent steps such as the formation of a gate insulating film, are carried out.

On the other hand, when the heat treatment is conducted wherein the substrate around the element isolation region is covered with an oxide film as in the present invention, even if the heat treatment is conducted in a nitrogen atmosphere, the formation of a thin nitride film requiring removal, such as would be produced according to the process of Kunikiyo, can be avoided. Thus, the present invention provides a more efficient production process than that shown in Kunikiyo.

In the present amendment, independent Claim 18 is amended to provide that the heat treatment takes place after forming a thermal oxide film in an element-forming area, that is, in the area where a gate oxide film and a gate electrode are to be formed, thereby further distinguishing the present invention from that of Kunikiyo.

Accordingly, it is respectfully submitted that Claims 18 - 20 and new Claims 28 - 36 are not anticipated by Kunikiyo.

Rejection of Claim 15 - 17 and 21 under 35 U.S.C. §103(a) over Kunikiyo in view of Chiu et al

Claims 15 - 17 and 21 were rejected under 35 U.S.C. §103(a) as obvious over Kunikiyo (U.S. Patent No. 5,668,403) in view of Chiu et al (U.S. Patent No. 5,470,783). Regarding Claims 15 and 21, the Examiner alleges that Kunikiyo teaches forming an element-separating oxide film on a silicon substrate by thermal

oxidation, and thereafter carrying out a heat-treatment at a temperature of not lower than 800°C while keeping a surface of the oxide film in an inert atmosphere, followed by formation of a gate oxide film, introduction of impurities, formation of electrodes and wiring, and formation of an insulating film so as to form a transistor, and that the heat-treatment of the oxide film is carried out after removal of an oxidation preventing film. The Examiner acknowledges that Kunikiyo fails to teach that the thermal oxidation is carried out at least in an atmosphere of a gaseous mixture of hydrogen and oxygen or in an atmosphere of H₂O. However, the Examiner alleges that Chiu teaches forming an element-separating oxide film in an atmosphere of a gaseous mixture of hydrogen and oxygen or in an atmosphere of H₂O. The Examiner takes the position that it would have been obvious to combine the teachings of Kunikiyo and Chiu et al. to enable forming the element-separating oxide film of Kunikiyo as taught by Chiu et al. Regarding Claim 16, the Examiner alleges that the combined teachings of Kunikiyo and Chiu teach that the heat treatment is carried out in an atmosphere of an inert gas selected from nitrogen, said gas mixture being able to contain 5% or less of oxygen. Regarding Claim 17, the Examiner alleges that the combined teachings of Kunikiyo and Chiu teach that the oxide film is kept in a bare state during the heat-treatment for stress relaxation.

This rejection is respectfully traversed as it may be applied to Claims 15 - 17 and 21 as amended herein and to new Claims 28 - 36. As discussed above, the process of the present invention comprises depositing a silicon nitride film on a substrate, forming a LOCOS (element separating oxide film), removing the deposited silicon nitride film, and conducting thermal treatment on the region of the substrate from which the silicon nitride is removed, said region of substrate having a

silicon oxide film thereon. The process includes an embodiment of a part of Example 1 wherein the pad oxide film is retained at the time of forming the pad oxide film on the substrate by thermal oxidation of the substrate before forming the silicon nitride film, and Example 2 wherein a thermal oxide film is formed on the substrate after formation of LOCOS.

In Kunikiyo, on the other hand, it is only disclosed that after forming a LOCOS oxide film, the nitride film 3 and the underlying oxide film 2 around the LOCOS are removed to expose the substrate 1, followed by heat treatment in a nitrogen atmosphere. Kunikiyo does not disclose that a high temperature heat treatment is conducted while the substrate around the element isolation region is covered with an oxide film as in the present invention.

When the heat treatment is conducted in a nitrogen atmosphere after forming the element isolation region, and exposing the substrate after removing the surface oxide film therearound as taught by Kunikiyo, the exposed substrate surface is subjected to formation of thin nitride film, which would have to be removed before subsequent steps such as the formation of a gate insulating film, are carried out.

On the other hand, when the heat treatment is conducted wherein the substrate around the element isolation region is covered with an oxide film as in the present invention, even if the heat treatment is conducted in a nitrogen atmosphere, the formation of a thin nitride film requiring removal, such as would be produced according to the process of Kunikiyo, can be avoided. Thus, the present invention provides a more efficient production process than that shown in Kunikiyo.

Even if Kunikiyo were combined with Chiu et al, the process of the present invention would not be obtained. Chiu relates to details of growing a field oxide, and

does not teach or suggest a subsequent heat treatment in an inert atmosphere to relax stress. Moreover, Chiu does not teach or suggest conducting a heat-treatment in an inert atmosphere in a state wherein the oxide film is formed on the surface of an element-forming area, that is, the area where a gate oxide film and a gate electrode are to be formed. The combination of Kunikiyo and Chiu does not teach or suggest a process wherein a heat treatment is carried out on a portion of a substrate having a oxide film thereon after removal of an oxidation-preventing film.

The present invention is further distinguished from Kunikiyo and Chiu by the present amendment, wherein independent Claim 15 is amended to provide that heat-treatment is performed after the oxidation-preventing film is removed so that when the heat treatment is performed, the oxide film in an element-forming area, that is, in an area where a gate oxide film and a gate electrode are to be formed is in a bare state. This feature is neither disclosed nor suggested by Kunikiyo and Chiu.

Accordingly, it is respectfully submitted that the combination of Kunikiyo and Chiu do not teach or suggest the present invention and that Claims 15 - 17 and 21 and new Claims 28 - 36 would not have been obvious over Kunikiyo and Chiu, alone or in combination.

Conclusion

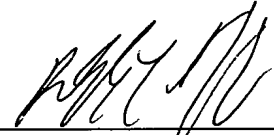
In view of the foregoing amendments and remarks, it is respectfully submitted that Claims 15 - 27 and new Claims 28 - 36 are in condition for allowance. Favorable reconsideration is respectfully requested.

Should the Examiner believe that anything further is necessary to place this application in condition for allowance, the Examiner is requested to contact

applicants' undersigned attorney at the telephone number listed below.

Kindly charge any additional fees due, or credit overpayment of fees, to
Deposit Account No. 01-2135 (500.34397CV2).

Respectfully submitted,
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